WHAT IS CLAIMED:

1. A cardiac pacing device comprising:

a) a battery,

b) a discrete time, switched capacitor pacing power supply comprising an internal charge transfer capacitor bank comprising at least two capacitors,

c) a pace output capacitor, and

d) a switch that can discharge current to tissue of a patient.

2. The cardiac pacing device of claim 1 wherein said switched capacitor pacing power supply has more than one programmable voltage multiplier settings, and more than one programmable operating frequency.

3. The cardiac pacing device of claim 1 wherein said switched pacing power supply is connected to a memory controlling voltage multiplier settings and operating frequency so that said voltage multiplier settings and said operating frequency are varied automatically by the device over the useful life of the battery.

4. The cardiac pacing device of claim 1 wherein said switched pacing power supply is connected to a memory controlling voltage multiplier settings and operating frequency so that said voltage multiplier settings and said operating frequency are varied automatically by the device over the useful life of the battery so that battery charge consumption is minimized.

5. The cardiac pacing device of claim 4 wherein a program minimizes battery charge consumption by selecting a minimum voltage multiplier setting, and switched capacitor pacing supply operating frequency consistent with restoring a requisite charge to the pace output capacitor in time for a next delivered output pulse.

6. The cardiac pacing device of claim 5 wherein the program, on average, from a beginning of life period for the battery to an end of life period for the battery, both the voltage multiplier setting and the average rate of said switching frequency increases.

7. The cardiac pacing device of claim 1 wherein a discharge capacitor is present within said device which is charged by said pacing power supply, and said discharge capacitor has a charging time, wherein the charging time is between 400msec (185ppm) and 2sec (30ppm).

8. The cardiac pacing device of claim 1 wherein the switching frequency rate is determined by a reading of the charge time or rate of charging of a storage capacitor with said pacing device.

9. The cardiac pacing device of claim 8 wherein, in response to said reading of the rate of the storage capacitor, the frequency is increased as the length of time to charge said storage capacitor increases.

10. A process for increasing the life of a battery in a cardiac pacing device comprising the steps of monitoring a feature within the cardiac pacing device which indicates the relative strength of the battery compared to beginning of life conditions, as said monitoring shows a decrease in said relative strength of the battery compared to beginning of life conditions, alternately configuring at least two capacitors in said cardiac pacing device which are used to store charge in a power supply for a discharge capacitor at a frequency of switching, and increasing the frequency of switching at which the at least two capacitors are alternatively configured in parallel configuration and a series configuration.

11. A process for charging a storage capacitor in a cardiac pacing device and then discharging the storage capacitor to effect a pace, the process comprising:

a. monitoring a feature within the cardiac pacing device which indicates the relative strength of a battery compared to a defined initial battery strength,

b. as said monitoring shows a decrease in said relative strength of the battery compared to said initial strength battery strength, alternately configuring at least two capacitors in said cardiac pacing device which are used to transfer charge from the power supply to the storage capacitor at a frequency of switching, and

c. increasing the frequency of switching at which the at least two charge transfer capacitors are alternatively configured in a charge filling phase from the battery and a charge delivery phase to a pace output capacitor.

12. The process of claim 10 wherein said monitoring is done by measuring a rate of charging for at least one capacitor in said cardiac pacing device.

13. The process of claim 11 wherein said monitoring is done by measuring a rate of charging for at least one capacitor in said cardiac pacing device.

14. The process of claim 11 wherein said frequency of switching and/or a functional setting on a multiplier effects a battery current profile that increases battery longevity from a standard frequency of switching and/or standard functional setting on a multiplier.

15. The process of claim 10 wherein each change in frequency is based upon a monitoring of a property or event in a previous pace or in a previous series of paces.

16. The process of claim 11 wherein each change in frequency is based upon a

monitoring of a property or event in a previous pace or in a previous series of paces.

17. The process of claim 12 wherein each change in frequency is based upon a monitoring of a property or event in a previous pace or in a previous series of paces.

18. The process of claim 13 wherein each change in frequency is based upon a monitoring of a property or event in a previous pace or in a previous series of paces.

19. The process of claim 11 wherein:

a) the operating frequency is initially set to a maximum rate;

b) then the voltage multiplier setting, Kx, is set to the minimum setting that is greater than Vpace/Vstop;

c) Kx is then decreased, and time is measured for how long it takes to recharge the pacing supply capacitor from a paced event or the charging rate to verify that the pacing supply capacitor is recharged within the cardiac pacing cycle interval;

d) Kx is decreased until the charge time becomes greater than a cardiac cycle interval; and

e) the Kx setting is restored to that just prior to a) for which charge time exceeds the cardiac cycle interval.

20. The process of claim 19 wherein once the minimum Kx setting is determined, the pacing supply operating clock is reduced so that charge is extracted from the battery at the minimum rate required to recharge pacing supply fully by a next commanded output pace.

21. The cardiac pacing device of claim 5 wherein said program is selected from the group consisting of software applications and hard-wired machine controls.

22. The cardiac pacing device of claim 4 using a fixed switched capacitor pacing supply operating frequency wherein a program maximizes charge delivered to the pacing output capacitor for a limited charge per unit time available from the battery, thereby minimizing pacing supply charge time.

23. A method for charging a storage capacitor in a cardiac pacing device and then discharging the storage capacitor to effect a pace, the process comprising:

a) during a filling phase, at least two charge transfer capacitors and a combination of switches inside said capacitor bank are configured to charge the charge transfer capacitors from the battery;

b) during a dump phase, the switch configuration is used to move charge from the transfer capacitors to a pacing supply output capacitor (28);

c) with a) and b) continuing until the pacing supply output capacitor is charged to a desired pace output voltage (Vset) as determined by a Vset voltage comparator;

d) the operating frequency of the charge transfer capacitor switches is varied over the useful life of the battery in order to control impedance presented to the battery terminals so that the battery pacing load current is approximately the average pacing supply charge required to replenish the pacing supply output capacitor divided by the cardiac cycle.

24. The method of claim 23 wherein operating frequency is adjusted so that charge is slowly extracted from the battery at a relatively uniform rate over the entire cardiac cycle.

25. The method of claim 24 wherein as the battery discharges over life and its output resistance increases, the pacing supply operating frequency is increased, lowering pacing supply impedance presented to the battery so that pacing supply output capacitor may be charged in time for the next pace command while keeping the battery load current constant.

26. A method for extending battery life in a cardiac pacing device that includes a pacing supply capacitor connected to a switching power supply and that is adapted to provide a series of pacing pulses from the pacing supply capacitor, the method comprising:

selecting a pacing supply operating frequency for the switching power supply to reduce a current required to recharge the pacing supply capacitor before a subsequent pacing pulse in the series of pacing pulses;

monitoring battery charge depletion that results in increasing charge times for the pacing supply capacitor; and

increasing the pacing supply operating frequency to compensate for the increasing charge times of the pacing supply capacitor.

27. The method of claim 26, wherein increasing the pacing supply operating frequency includes decreasing an input impedance of a switched capacitor supply in the cardiac pacing device an amount to offset an internal battery impedance gain attributable to the battery charge depletion so as to maintain a relatively uniform current required to recharge the pacing supply capacitor before the subsequent pacing pulse.

28. The method of claim 26, wherein monitoring battery charge depletion includes measuring a charge time for recharging the pacing supply capacitor.

29. The method of claim 26, wherein increasing the pacing supply operating frequency to compensate for the increasing charge times of the pacing supply capacitor attributable to battery charge depletion includes increasing the pacing supply operating frequency settings to a discrete frequency setting from a number of discrete frequency settings.

30. The method of claim 29, further including providing the number of discrete frequency settings by dividing an input clock frequency (f) by a programmable integer count (n) such that the number of discrete frequency settings are provided by f / n for a given set of n, wherein n is an integer selected from a range of integers 1 through m.

31. The method of claim 30, further including providing the given set of n as a function of 2^x, wherein x is an integer from a programmable counter.

32. The method of claim 31, wherein providing the given set of n as a function of 2^x includes providing 128, 64, 32, 16, 8, 4, 2, 1 as the given set of n.

33. The method of claim 26, further comprising:

recharging the pacing supply capacitor using a sequence of charge transfer cycles in which a removed battery charge for each charge transfer cycle exponentially diminishes along the sequence of charge transfer cycles as the pacing supply capacitor is charged; and

varying a time interval between charge transfer cycles such that the sequence of charge transfer cycles is an inverse of the exponentially diminishing removed battery charge.

34. The method of claim 33, wherein varying a time interval between charge transfer cycles includes:

counting a number of fill-dump cycles (N) needed to recharge the pacing capacitor following a pace;

determining a paced cardiac cycle interval (Tcyc);

measuring an increase in voltage (ΔVTotal) added to the pacing supply capacitor following the pace; and

loading a presettable delay counter (Ti) for a next charge transfer cycle interval (I) with Ti = Tcyc (ΔV(I)/ΔVTotal).

35. The method of claim 26, further comprising increasing a voltage multiplier setting for the switching power supply to compensate for battery charge depletion.

36. The method of claim 35, further comprising choosing the voltage multiplier setting from a multiplicity of voltage multiplier settings that includes at least one voltage attenuation setting.

37. The method of claim 36, further comprising choosing the voltage multiplier setting from 0.5x, 0.66x, 1.0x, 1.5x, 2.0x, 3.0x.

38. A method for extending battery life in a cardiac pacing device that includes a pacing supply capacitor connected to a switching power supply and that is adapted to provide a series of pacing pulses from the pacing supply capacitor, the method comprising:

setting a pacing supply operating frequency setting for the switching power supply to a first rate that is greater than a setting in which a charge time for the pacing supply capacitor is greater than a cardiac cycle interval;

setting a voltage multiplier setting for the switching power supply to a reduced setting that is greater than Vpace/Vstop; and

reducing the pacing supply operating frequency setting to a reduced setting that is greater than the setting in which the charge time for the pacing supply capacitor is greater than the cardiac cycle interval.

39. The method of claim 38, wherein reducing the pacing supply operating frequency setting to a reduced setting includes reducing the pacing supply operating frequency by a number of discrete frequency settings.

40. The method of claim 39, further including providing the number of discrete frequency settings by dividing an input clock frequency (f) by a programmable integer count (n) such that the number of discrete frequency settings are provided by f / n for a given set of n.

41. The method of claim 40, further including providing the given set of n as a function of 2^x, wherein x is an integer from a programmable counter.

42. The method of claim 41, wherein providing the given set of n as a function of 2^x includes providing {128, 64, 32, 16, 8, 4, 2, 1} as the given set of n.

43. The method of claim 39, further including gradually increasing the pacing supply operating frequency over a time period of diminishing battery charge.

44. The method of claim 39, further including gradually increasing the pacing supply operating frequency at specific time intervals after pacemaker activation in a patient.

45. The method of claim 39, further including:

reading a feature that indicates a battery strength; and

increasing the pacing supply operating frequency to compensate for battery charge depletion upon reading a feature that indicates battery charge depletion.

46. The method of claim 45, wherein reading a feature that indicates a battery strength includes determining a current.

47. The method of claim 45, wherein reading a feature that indicates a battery strength includes determining a voltage.

48. The method of claim 45, wherein reading a feature that indicates a battery strength includes determining a battery resistance.

49. The method of claim 45, wherein reading a feature that indicates a battery strength includes measuring a charge time of a pace storage capacitor.

50. A cardiac stimulating device, comprising:

a power terminal for a battery;

a pacing supply capacitor; and

a switching power supply connected to the power terminal and the pacing supply capacitor, and adapted for receiving current from the battery and charging the pacing supply capacitor, the switching power supply including:

at least two capacitors having a fill configuration for receiving charge from the battery and a dump configuration for transferring charge to the pacing supply capacitor; and

a frequency input for controlling a switching frequency between the fill configuration and the dump configuration such that the switching frequency is capable of being adjusted to extend battery life.

51. The device of claim 50, wherein the switching power supply includes a modifiable switch topology and a voltage input for controlling a voltage multiplier setting from the power terminal to the pacing supply capacitor by modifying the switch topology.

52. The device of claim 51, wherein the voltage multiplier setting is chosen from a multiplicity of voltage multiplier settings that includes at least one voltage attenuation setting.

53. The device of claim 52, wherein the multiplicity of voltage multiplier settings include 0.5x, 0.66x, 1.0x, 1.5x, 2.0x, 3.0x.

54. The device of claim 51, further comprising a memory that contains executable instructions to automatically vary the voltage multiplier setting and the switching frequency.

55. The device of claim 50, further comprising a memory that contains executable instructions to automatically vary the switching frequency.

56. The device of claim 50, further comprising frequency controlling circuitry connected to the frequency input of the switching power supply.

57. The device of claim 56, wherein the device is an implantable device, and the frequency controlling circuitry is adapted to noninvasively vary the switching frequency to extend battery life.

58. The device of claim 56, wherein the frequency controlling circuitry is adapted to gradually change the switching frequency over a time period in which a battery charge is expected to diminish.

59. The device of claim 56, wherein the frequency controlling circuitry is adapted to gradually change the switching frequency at specific time intervals after device activation using a timing function.

60. The device of claim 56, wherein the frequency controlling circuitry is adapted to read a feature that indicates a battery strength, and vary the switching frequency based on the feature.

61. The device of claim 60, wherein the frequency controlling circuitry is adapted to determine a current as an indication of battery strength.

62. The device of claim 60, wherein the frequency controlling circuitry is adapted to determine a voltage as an indication of battery strength.

63. The device of claim 60, wherein the frequency controlling circuitry is adapted to determine a battery resistance as an indication of battery strength.

64. The device of claim 60, wherein the frequency controlling circuitry is adapted to measure a charge time of a pace storage capacitor as an indication of battery strength.

65. The device of claim 56, wherein the frequency controlling circuitry includes a programmable frequency divider connected to the frequency input, wherein the programmable frequency divider includes a programmable counter and is adapted to digitally divide a clock reference by an integer n using the programmable counter.

66. The device of claim 65, wherein the frequency controlling circuitry is adapted to provide a set of integer n a function of $n = 2^x$, wherein x is an integer from the programmable counter.

67. The device of claim 65, wherein the frequency controlling circuitry is adapted to provide 128, 64, 32, 16, 8, 4, 2, 1 as the set of integer n.

68. The device of claim 50, wherein the frequency controlling circuitry is adapted to control impedance presented to the power terminal so as to provide a relatively uniform current that is approximately the average charge required to replenish the power supply capacitor divided by a cardiac cycle.

69. A cardiac stimulating device, comprising:

a power terminal for a battery;

a pacing supply capacitor;

a switching power supply connected to the power terminal and the pacing supply capacitor, and adapted for receiving current from the battery and charging the pacing supply capacitor, the switching power supply including at least two capacitors with a fill configuration for receiving charge from the battery and a dump configuration for transferring charge to the pacing supply capacitor; and

frequency controlling circuitry for controlling a switching frequency between the fill configuration and the dump configuration such that the switching frequency is capable of being adjusted to extend battery life, the frequency controlling circuitry being adapted to:

control impedance presented to the battery terminal by adjusting the switching frequency so as to provide a relatively uniform current that is approximately an average charge required to replenish the pacing supply capacitor divided by a cardiac cycle;

read a feature that indicates a battery strength; and

alter the switching frequency based on the feature.

70. The device of claim 69, wherein the frequency controlling circuitry is adapted to determine a current to indicate battery strength.

71. The device of claim 69, wherein the frequency controlling circuitry is adapted to determine a voltage to indicate battery strength.

72. The device of claim 69, wherein the frequency controlling circuitry is adapted to determine a battery resistance to indicate battery strength.

73. The device of claim 69, wherein the frequency controlling circuitry is adapted to measure a charge time of a pace storage capacitor to indicate battery strength.

74. The device of claim 69, wherein the frequency controlling circuitry includes a programmable frequency divider connected to the frequency input, wherein the programmable frequency divider includes a programmable counter and is adapted to digitally divide a clock reference by an integer n using the programmable counter.

75. The device of claim 69, wherein the switching power supply includes a modifiable switch topology and a voltage input for controlling a voltage multiplier setting from the power terminal to the pacing supply capacitor by modifying the switch topology.

76. The device of claim 75, further comprising a memory that contains executable instructions to automatically vary the voltage multiplier setting and the switching frequency.

77. The device of claim 69, further comprising a memory that contains executable instructions to automatically vary the switching frequency.

78. The device of claim 69, wherein the device is an implantable device, and the frequency controlling circuitry is adapted to noninvasively vary the switching frequency to extend battery life.